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Efficacy of Telepractice as a Service Delivery Model for Teaching AAC Symbols to An Adult with Severe Communication Impairment and ASD: A Case Study

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Efficacy of Telepractice as a Service Delivery Model for Teaching AAC Symbols to An Adult with Severe Communication Impairment and ASD: A Case Study

by

Madison Anne Morris

Thesis

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Dedication

For Julie. This work is a culmination of years of studying, failing, succeeding, and never looking back. Thank you for providing me with this opportunity.

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This project would not have been possible without the effort and support of several incredible individuals. I would like to first thank my thesis mentor, Tiffany Chavers. It has been a pleasure to work with you on a project of my own and your mentorship has been irreplaceable for me both as a researcher and a clinician. You have a remarkable skill for teaching and you are both a clinician and research I immensely aspire to be like.

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Abstract

Efficacy of telepractice as a service delivery model for teaching AAC Symbols to an individual with severe communication impairment and ASD: A Case Study.

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The University of Texas at Austin, 2021

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The purpose of this case study was to evaluate the effectiveness of telepractice as a service delivery model in teaching graphic symbols depicting emotions to an individual with severe Autism Spectrum Disorder and limited functional communication. The adult participant was trained to identify Picture Communication Symbols® (PCS®) over the Zoom™ platform. The procedures included a baseline followed by intervention and a generalization probe. During baseline, the participant's ability to identify Picture Communication Symbols® and Symbolstix® depicting emotions was measured. The intervention focused on teaching identification of PCS® depicting emotions using systematic instruction. Generalization across symbol sets was measured using Symbolstix® symbols. Results indicated that the participant's identification of PCS® symbols that depict emotions increased by 50% from baseline to post-intervention. The participant's generalization to untrained Symbolstix® symbols increased by 18.75%. These preliminary results indicate potential for using telepractice platform for teaching abstract symbols to adults with severe Autism Spectrum Disorder.

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I. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is characterized by impairment in social interaction, speech and nonverbal communication, and restricted and repetitive behaviors (American Psychiatric Association, 2013). Approximately 30-40% of individuals diagnosed with ASD fail to develop functional speech and remain nonverbal or minimally verbal throughout their life span (Howlin et al., 2014; Pickles et al., 2014; Tager-Flusberg & Kasari, 2013). Augmentative and Alternative Communication (AAC) involves “attempts to compensate for temporary or permanent impairments, activity limitations, and participation restrictions of individuals with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communication” (ASHA, n.d.). The term ‘augmentative’ refers to supplementing and ‘alternative’ implies replacement of natural speech and/or writing. AAC techniques and strategies are typically classified into two broad categories: aided and unaided (Mirenda, 1999). Unaided AAC strategies involve using hand gestures, facial expressions, pointing, and stereotypic utterances for communication purposes (Koul, 2011). Aided communication requires a form of external support such as a communication book, communication board, graphic symbols, technologically-based dedicated speech generating devices (SGDs) and apps that turn multipurpose consumer devices into SGDs (Koul, 2011). Research indicates that both aided and unaided AAC are effective modes of communication for individuals with little to no functional speech (Ganz et al., 2012; Gevarter et al., 2013; Hart & Banda, 2010; Preston & Carter, 2009). However, aided AAC strategies, including SGDs, tend to be relatively more efficient and are rated by caregivers as a preferred method of communication (Gevarter et al., 2013). Ganz (2015) conducted a systematic review that indicated that aided AAC is more effective than unaided AAC in improving variety of communicative behaviors such as requesting and protesting. However, additional research is warranted in behaviors that facilitate social-communicative interactions.

Clinicians and researchers have used aided and unaided AAC strategies to augment or replace natural speech to facilitate communication for individuals with ASD and severe communication impairment. Graphic symbols are implemented widely in most aided AAC systems whether these systems are a low-tech communication board or a high-tech SGD. People with ASD who use aided AAC with graphic symbols use these symbols to express their wants, needs and thoughts by pointing to them, touching the symbols and activating the speech output representing those symbols, or giving the symbols to a communication partner (e.g., PECS®). These individuals also use these graphic symbols for receptive purposes when communication facilitators provide augmented input. Graphic symbols from some sets (e.g., PCS®) are easier to guess and learn when representing the word class of nouns relative to other parts of speech such as verbs, adjectives, and prepositions (Schlosser et al., 2019). Tsai (2013) observed that adults from 18 to 40 years of age preferred PCS® to other AAC symbol sets. However, a significant barrier to using PCS® is that these symbols are not readily available on multipurpose consumer devices such as the iPad®, iPhone® and iPod Touch®. To get access to PCS®, additional software and devices must be purchased. These traditional SGDs are costly and insurance companies do not always cover these costs (Lorah, Parnell, Whitby & Hantula, 2015). The development of Proloquo2Go™, an app furnished with Symbolstix® by n2y® provide iPad® and iPhone® users with greater access to a large number of graphic symbols at a significantly lower cost (AssistiveWare B.V, 2021; n2y LLC., 2021; Lorah, Tincani, & Parnell, 2018, Sennott & Bowker 2009). A significant body of research has shown the use of AAC apps like Proloquo2Go™ are just as effective as a dedicated SGD for teaching communicative skills such as multi-step requesting and social comments to children with ASD (Achmadi et al., 2012; Agius, May, & Vance, 2016; Alzrayer et al.,2014, 2017, 2019; King et al., 2014; Meeks, 2017; Nepo et al., 2017; Sigafoos et al., 2013; Waddington et al., 2014). Van Der Meer et al. (2015) observed that a student with severe ASD and severe communication impairment demonstrated improved picture-to-word matching skills after systematic intervention using Symbolstix® with the Proloquo2Go™ app.

Previous research indicates that AAC intervention is effective in facilitating early communicative behaviors in children with ASD (Bock et al., 2005; Genc-Tosun & Kurt, 2017; Gosnell, Costello, & Shane, 2011; Hetzroni & Roth, 2003; Hill, 2010; Millar, Light, & Schlosser, 2006; Mirenda, 2001, 2003; Schepis et al., 1998). These studies observed maintenance of acquired behaviors and generalization across communicative behaviors after intervention was completed. Though most research on intervention for ASD focuses on children, adults with the ASD continue to struggle with communication and language difficulties (Howlin, 2000; Liptak, Kennedy & Dosa, 2011; Sigman & Mcgovern 2005; Whitehouse et al., 2009). However, research suggests AAC intervention is also highly effective for adults with ASD (Banda et al., 2010; Hong et al., 2014; Kee et al., 2012; Sigafoos, Drasgow et al., 2004; Sigafoos, O'Reilly, et al., 2004 ; Reichle et al., 2005).

To date, AAC intervention has largely taken place via in-person settings, but the COVID-19 pandemic has increased the urgency for speech language pathologists and audiologists to incorporate telepractice, or virtual therapy sessions as a routine service delivery option (Fong, Tsai, & Yiu, 2021; Kollia & Tsiamtsiouris, 2021; Lam, Lee, & Tong, 2021; Tohidast et. al, 2020). A survey of 27,041 ASHA-certified SLPs about the use of telepractice prior to pandemic and during the pandemic showed a shift from 25% of SLPs using telepractice before pandemic to 85% during the pandemic (The ASHA Leader Live, 2020). Previous research indicates that speech and language assessment and intervention completed via telepractice may be as effective as in-person service delivery (Carey et al., 2014; Crutchley, Dudley, & Campbell, 2010; Dimer et al 2020; Grogan-Johnson et al., 2010; Hao et al., 2020; Rangarathnam et al., 2015; Reese et al., 2013; Waite et al., 2010; Zughni et al., 2020). Telepractice is a service-delivery option that is no longer supplementary and should be utilized as a main resource due to the need for remote service options.

Thus, the overall purpose of this study was to evaluate the effectiveness of teaching symbol-referent relationships for symbols depicting emotions using a telepractice platform with an adult with severe ASD and little to no functional speech.

1.1 ASD AND EMOTION

Emotions are a "core part of human interaction" and "essential basic vocabulary" (Wilkinson & Snell, 2011). A crucial element of appropriate social interaction is emotional competence. Emotional competence involves skills related to recognizing and labeling one's own emotions and the emotions of others (Na et al., 2016). This skill also requires managing and responding to emotions that are recognized; as well as engaging in empathetic communication (Na et al., 2016). Emotional competence is ultimately related to outcomes for learning and the development of social relationships.

Individuals with ASD struggle with emotional reciprocity, identifying others' and their own emotions, and understanding others' emotions (American Psychiatric Association, 2013). Previous studies have found that individuals with ASD have difficulty identifying emotions, especially negative ones (Ashwin et al., 2006; Bal et al., 2010; Corden et al., 2008; Eack, Mazefsky & Minshew, 2014; Howard et al., 2000; Montgomery et al., 2016; Wallace et al., 2008). Lozier & Vanmeter (2014) observed that individuals with ASD often recognize facial expressions with the wrong emotion. This facial-emotion recognition deficit increases with age and is independent of overall cognitive function (Lozier & Vanmeter, 2014).

There is a substantial body of research that suggests emotional competence and communicative competence are related (Bradley et al., 2001; Petty, Allen, & Oliver, 2009; Saarni, 2011; Wilkinson & Snell, 2011, Vygotsky, 1978). At an empirical level, these studies have primarily involved children who are typically developing. For example, studies conducted with typical children found that children with advanced language skills also have well-developed emotion regulation skills (Roben et al., 2013; Vallotton & Ayoub, 2011). Research indicates that children who experience language delay/disorders demonstrate poorer self-regulation skills (e.g., Aro et al., 2014). This suggests a strong relationship between communicative competence and emotions. Thus, the relationship between communicative competence and emotion is a critical target for intervention for individuals with ASD with limited communication who struggle both with the understanding emotions of others and social communication in general.

1.2 AAC and Emotions

Communicating about emotion is challenging for individuals who use aided AAC due to factors both intrinsic to the individual (e.g., difficulty in communicating including expressing emotions due to physical, motor, linguistic, sensori-perceptual or cognitive challenges) and extrinsic factors such as partners not trained to support AAC techniques and strategies (Blackstone & Wilkins, 2009). Additionally, Blackstone & Wilkins (2009) observed that children frequently did not have adequate access to the variety of emotion symbols they needed for communicative purposes. If the children did have an appropriate assortment of different emotion symbols, then they were not trained to use them in the appropriate contexts (Blackstone & Wilkins, 2009).

Lastly, Blackstone & Wilkins (2009) observed that it is important that individuals who use aided AAC be able to discuss their emotions in a culturally appropriate manner.

A number of studies have investigated the factors that facilitate identification of symbols that depict emotions (DeKlerk, Dada & Alant, 2014; Visser, Alant & Hardy, 2008). Typically developing 4-year-olds identified symbols for emotions with greater accuracy depending on the spatial arrangement of the symbols and the background color of the display (Wilkinson, Krista, & Snell, 2011). Visser, Alant & Hardy (2008) investigated whether typically developing English-speaking 4- year-olds would choose the same expected graphic symbol for each of the four basic emotions ("happy", "sad", "angry", "afraid"). The children were presented with 3 different graphic symbols of the emotion (i.e., 3 different graphic symbols representing "happy"). Results indicated that 99% of the children selected the expected graphic symbol for the emotion "happy", 85% of the children selected the expected symbol for "angry", 74% selected the expected symbol for "afraid" and 73% selected the expected symbol for "sad" (Visser, Alant & Harty, 2008). A follow-up study with 5-year-old children who spoke either Afrikaans or Sepedi were also able to recognize those symbols and their accuracy was greater for positive emotions than negative ones (DeKlerk, Dada & Alant, 2014). These results supported the earlier findings reported by Visser, Alant & Hardy (2008).

Additionally, previous studies have investigated the efficacy of AAC intervention with emotional competence as a goal (Na et al., 2016; Na & Wilkinson, 2018). Strategies for talking about emotions as partners (STEPS), an instructional program for parents to promote communicating about emotions in the context of AAC was effective for improving opportunities for comments about emotions in children with Down Syndrome during a storybook reading task (Na & Wilkinson, 2018). However, research needs to be conducted with adults with ASD with little to no functional speech in the context of socioemotional communication abilities. Intervention and training in the areas of emotion-recognition and emotional competence could help adults communicate more effectively with both familiar and unfamiliar communication partners.

1.3 TELEPRACTICE

The Covid-19 pandemic has changed the way the world did many things, including the way speech and language therapy is delivered. The therapeutic world focused on telepractice as a service delivery option throughout 2020 due to the pandemic (Kollia & Tsiamtsiouris, 2021). ASHA defines telepractice as "the application of telecommunications technology to the delivery of speech language pathology and audiology professional services at a distance by linking clinician to client or clinician to clinician for assessment, intervention, and/or consultation" (ASHA, n.d.). Telepractice can allow clinicians to reach individuals who live in rural areas or have difficulty making arrangements to travel to in-person appointments (Lowman and Kleinert, 2017). In fact, parents, SLPs and students both report high overall satisfaction with a school telepractice speech program in rural Oklahoma (Scheidemann-Miller et al., 2002). Some schools have adopted telepractice as a solution to the problem of a shortage of SLPs in rural areas (Lowman & Kleinert, 2017). Telepractice has proven to be just as effective as in-person therapy for both assessment and treatment (Carey et al., 2014; Crutchley, Dudley, & Campbell, 2010; Dimer et al 2020; Grogan-Johnson et al., 2010; Hao et al., 2020; Rangarathnam et al., 2015; Reese et al., 2013; Waite et al., 2010; Zughni et al., 2020). A study observing whether synchronous telepractice would be more cost effective for head, neck and cancer patients receiving speech-language pathology services, reported average cost savings of 12%, saving $40.05 per patient per referral, when using telepractice instead of standard care (Burns et al., 2017). This suggests that telepractice could be potentially more cost-effective than standard care.

1.3.1 TELEPRACTICE AND ASD

Research conducted on service delivery using telepractice to individuals with ASD has been largely promising (Boisvert et al., 2010, 2012; Ellison et al., 2021; Hao et al., 2020; Lindgren et al., 2016; Pollard et al., 2020). Ellison et al. (2021) conducted a systematic review of 55 studies involving ASD assessment and intervention via telepractice, finding that the majority of the studies produced favorable outcomes for telepractice as a service delivery model for ASD. This matched previous findings in similar systematic reviews (Boisvert et al., 2010; Sutherland et al., 2018). Lindgren et al. (2016) found that coaching parents on applied behavior analysis (ABA) techniques to implement with their child via telepractice was as effective as being delivered in-person. Additionally, no difference was observed in the efficacy of training parent-mediated social communication intervention between groups of parents of children with ASD when delivered in-person or via telepractice (Hao et al., 2020). Boisvert et al. (2012) completed a review of two case studies about individuals with ASD completing therapy via telepractice. They observed that one participant made "advancement towards his IEP goals" and the other participant "demonstrated beneficial outcomes in language production as expressed using a SGD [Speech Generating Device]". A systematic review analyzing eight different studies involving telepractice and ASD intervention reported successful implementation of telepractice as a service delivery model in 7 of the 8 studies (Boisvert et al., 2010). Initial research conducted during the COVID-19 crisis found that some clients with ASD can benefit from technician-delivered telehealth services for ABA (Pollard et al., 2020).

Despite growing support for telepractice intervention with children, limited research as to the effectiveness of telepractice exists for adults with ASD and other developmental disabilities (Tang et al., 2020, Pellegrino & Reed, 2020). Recently, a social emotional tool called MindChip™

was developed as a telehealth intervention tool for adults with ASD to provide guidance and skills for navigating emotion processing and emotion recognition. The users of MindChip™ agreed it was fun, helpful in learning and recognizing emotions, and relevant to everyday life (Tang et al., 2020). Additionally, a study teaching everyday life skills (i.e. following recipes) to 2 adults with intellectual and developmental disabilities found that the individuals met mastery for their goals in fewer than 15 videoconferencing sessions and maintained their progress after 2 weeks (Pellegrino & Reed, 2020).

1.3.2 Telepractice and AAC

There is a limited evidence supporting telepractice as a service delivery model for AAC evaluation and intervention (Anderson et al., 2015; LoPresti et al., 2015). Caregivers of individuals using AAC see benefits of telepractice, particularly for individuals in rural/remote areas and underserviced clients (Anderson et al., 2015). Moreover, research has found that individuals using AAC are comfortable being evaluated and treated through telepractice (Lopresti et al., 2015). This research suggests that both caregivers and users of AAC themselves are not opposed to using telepractice as a service delivery model, but additional research needs to be conducted in this area to examine efficacy of the intervention.

1.4 Current Study

The purpose of this case study was to evaluate the effectiveness of telepractice as a service delivery model in teaching graphic symbols depicting emotions to an individual with severe ASD and limited functional communication. The following two research questions were addressed:

1.) Is teletherapy an effective mode of treatment for teaching a participant with ASD and little or no functional speech to identify PCS® that depict emotion?

2.) Will the participant be able to generalize the symbol-referent relationship to untrained Symbolstix® symbols?

II. Methods

2.1 PARTICIPANT

One adult with ASD participated in this case study. A pseudonym (Eli) is used here to protect the privacy of the participant.

Eli is a 21-year-old male with severe ASD and limited functional communication skills. He was diagnosed with ASD at 18 months by a neurologist. He lives with his mother in Texas and attends online public school via Zoom™. He has a history of seizures and takes medication to control the seizures. Eli frequently used gestures or non-speech forms of communication and severely perseverated on auditory, visual and tactile stimuli. His Childhood Autism Rating Scale-2nd edition (CARS-2) score was 43, indicating severe ASD. His Peabody Picture Vocabulary Test, Version 5 (PPVT-5) standard score was 40, percentile rank <0.1, suggesting poor receptive language skills. He did not use AAC, though his mother reported AAC strategies were attempted in the past. His hearing and vision were appropriate for the experimental tasks and he had access to wi-fi and a computer and a tablet.

Eli's strengths included having a happy temperament and enjoying learning. Eli's mother reported slow processing of information and self-biting behavior. Eli's expressive communication was primarily characterized by echolalia of 1-3 words, which he did frequently. He required verbal prompts from his mother for most communicative verbal output (e.g. saying hello/goodbye, answering questions). Eli also required prompting for non-speech communication (e.g. waving hello/goodbye, pointing).

Eli was recruited through The Texas Autism society listserv and Texas Tech Autism listserv and consented under IRB #2020-06-0112.

2.2 Materials

2.2.1 Laptop, Smartphone and Zoom™ platform

A PC laptop was used to conduct AAC teletherapy intervention. The *Zoom™* app was downloaded onto the PC laptop (Zoom™ Communications Incorporated, 2021). The other device used to conduct experimental intervention was a smart phone that also contained the *Zoom™* app. Figures 1 and 2 provides screenshots of the Zoom™ app view on the laptop and the smartphone respectively. *Zoom™* is a videoconferencing tool that allows users to conduct meetings online via voice, video, and/or chat. During a Zoom™ meeting, the researcher's shared screen filled most of the screen and Eli's video was smaller on the bottom right corner of the screen to allow the researcher to be able to see Eli and his mother during sessions. On the bottom of the screen, there was home bar that had features to enhance the meeting's experience. These features serve various functions, including: (1) muting and unmuting audio or starting and stopping video via the microphone and video icons; (2) access security and manage participants using the security and participants icons; (3) the chat icon to communicate with participants during the session; (4) share content and record the meeting using the share screen icon and record icon; (5) ask questions or provide captions using the polling icon or the closed caption icon; (6) separate participants into different video calls or broadcast the session on another platform like Facebook or Youtube via the breakout rooms icon and the more icon; and (7) stop the meeting or leave by using the end or leave meeting icons. The features used in this study were the screen-share feature and the annotate feature. Screen sharing allowed for the researcher to broadcast the view of their screen for the participant and caregiver to see. The annotate feature allowed for the participant to be able to make selections and mark on the screen that the researcher was sharing. The *Zoom™* account used for this study was the researchers' UT account which had multi-factor authentication via Duo. The researcher used a HIPAA compliant Zoom™ account for all enabled communication features. The waiting room feature was enabled so the researcher was able to identify the participant before admitting them into the Zoom™ call.

Figure 1: Zoom™ PC view with screenshare feature enabled

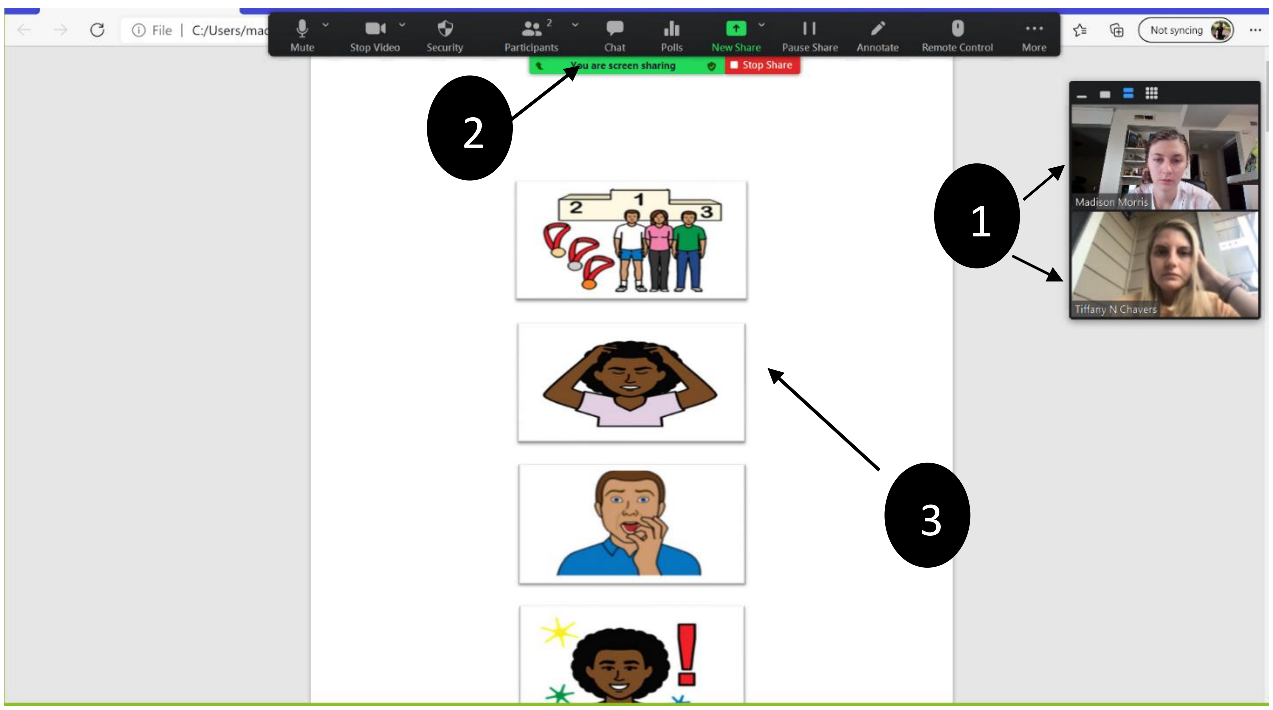


Figure 1: 1. Researcher and Participant's video view, 2. Zoom™ task bar with screen share feature enabled, 3. The document the researcher is sharing.

Figure 2: Zoom Mobile App View with screenshare feature enabled

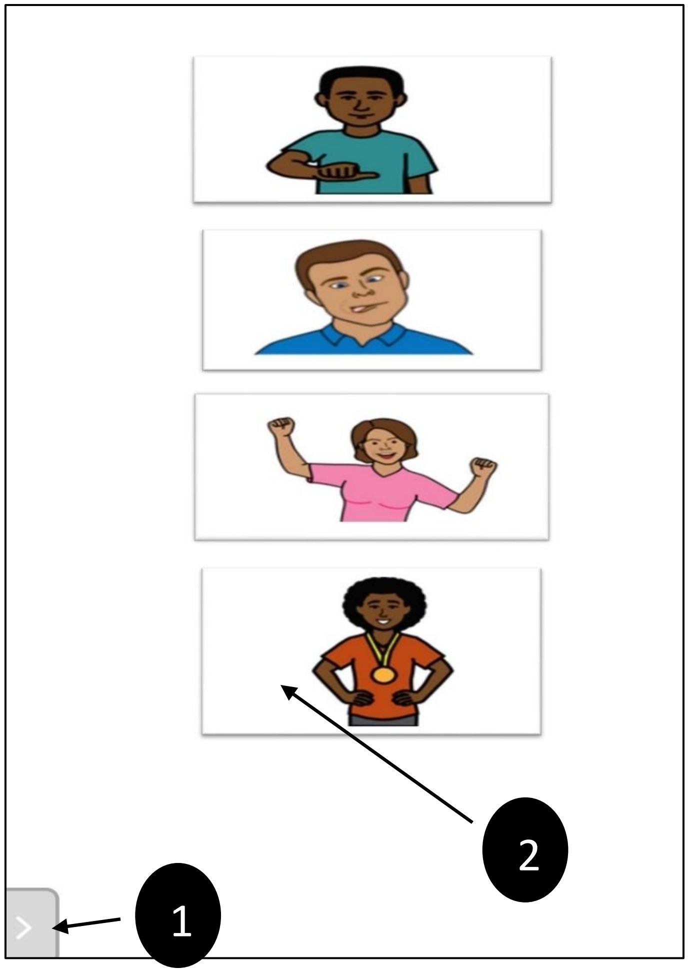


Figure 2: 1. Drop back menu arrow for Zoom 2. Document researcher is sharing.

2.2.2 Symbols

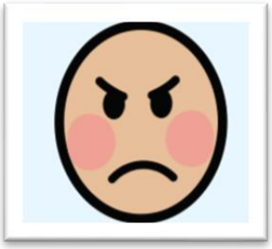
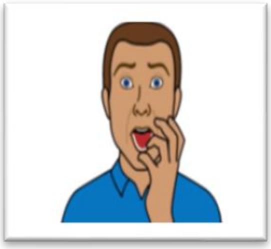
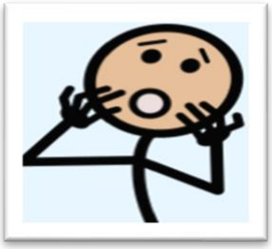
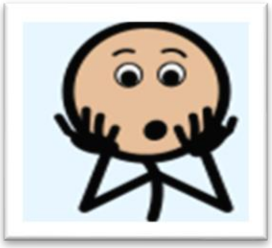
Two different types of symbols were used in this study (Figure 3); Picture Communication Symbols® (PCS®; Mayer-Johnson Company, 1994) and Symbolstix® (n2y® LLC, 2021). PCS® symbols are primarily line drawings that depict actions, objects, emotions, and other concepts. Similarly, Symbolstix® are stick figure drawings that depict actions, objects, emotions and other concepts. The Symbolstix® symbol set is widely used in many apps including the

Proloquo2Go™ app (AssistiveWare B.V., 2021). PCS® was the symbol set that was trained during intervention, while Symbolstix® was baselined pre-intervention and then used to evaluate generalization for untrained items.

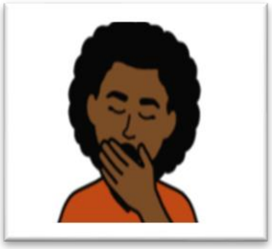
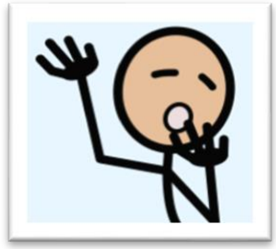
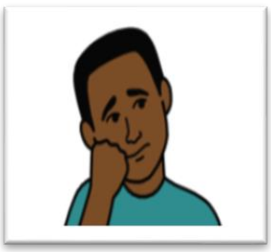
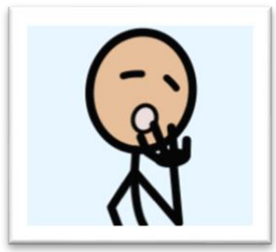
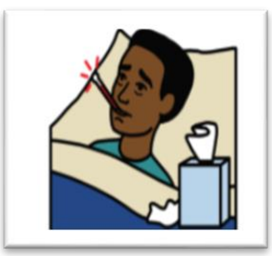
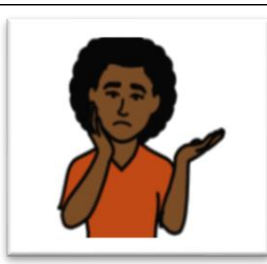
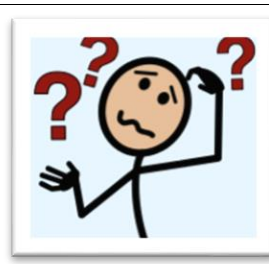
The following criteria were used for selecting symbol stimuli that depicted emotions: (a) categorized as "feelings" in the symbol library for PCS® and, (b) had identical referents in Symbolstix® symbol set (Sennott & Bowker, 2009; n2y LLC, 2021). The symbols depicting emotions that met these criteria included: "happy", "sad", "angry", "scared", "frustrated", "homesick", "excited", "hopeful", "silly", "tired", "bored", "sick", "confused", "embarrassed", "love", "jealous", "surprised", and "lonely" (Figure 3).

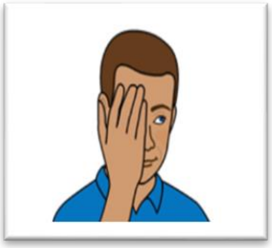
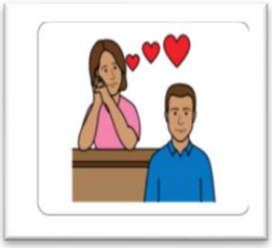
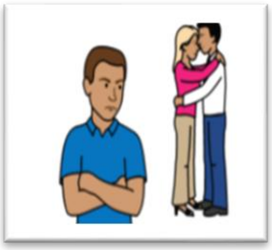
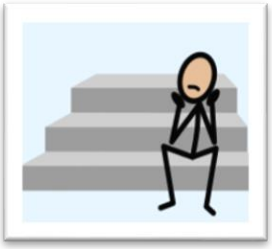
Figure 3: Experimental symbol stimuli depicting emotions across two symbol sets

Emotion	PCS®	**Symbolstix®**
Happy		
sad		

Angry		
Scared		
Surprised		
Frustrated		

Homesick		
Excited		
Hopeful		
Silly		

Tired		
Bored		
Sick		
Confused		

Embarrassed		
Love		
jealous		
Lonely		

2.3 PROCEDURES

The study included a pre-experimental phase, baseline phase, intervention phase, and a generalization phase. Experimental sessions were conducted three times a week for approximately 20-30 minutes. The baseline and intervention sessions occurred over a 2-month period.

2.3.1 Pre-Experimental Procedures

Eli was administered two formal assessments via *Zoom™* to determine his receptive language skills and the severity of ASD. First, the researcher administered the Peabody Picture Vocabulary Test, fifth edition (PPVT-5; Dunn, 2019) to assess Eli's one-word receptive vocabulary. The PPVT-5 measures the receptive vocabulary knowledge of an individual for nouns, verbs, and other parts of speech (Dunn, 2019). The online version of the PPVT-5 was administered via Pearson's *Qglobal* tool, an online resource that allows electronic completion and scoring of standardized tests (Pearson, 2021). Additionally, the researcher administered the CARS-2 (Schopler et al., 2010) to assess ASD severity

Zoom™ Training Task and Caregiver Training

Before the baseline and intervention phases, Eli's mother underwent two Zoom™ training sessions with the researcher. These training sessions focused on testing audio quality, video quality and wi-fi bandwidth to ensure the least possibility of interruption when the study began; and to educate the caregiver about their role in the study. The researcher provided both written and verbal instructions on how to access and use the annotate feature on Zoom™. The researcher and Eli's mother practiced setting up the annotate feature prior to the beginning of the experiment.

Next, Eli's mother was informed about the structure of the study including individual phases (baseline, intervention, generalization) and how to assist appropriately in sessions during each phase. She was instructed to make no attempt to teach, cue, or reinforce during baseline phase, and how to appropriately use hand-over-hand cueing during intervention sessions. The researcher also used the training sessions to answer any questions Eli's mother had about the experimental procedures.

Symbol Selection Assessment

The final step before intervention was the symbol selection assessment. PCS® symbols were used to select symbols for the intervention phase. Specifically, the researcher instructed Eli to "click on the 'happy' face", "click on the 'sad' face", or "click on the 'angry' picture/person", etc. After prompting Eli, the researcher waited for 15 seconds. The researcher repeated the question once more if Eli did not respond. If Eli identified the symbol correctly, it was not added to the intervention symbol list for Eli. If the symbol was identified incorrectly, then it was added to the symbol list. If Eli still did not respond after the researcher had repeated the prompt, the symbol was also added to Eli's symbol intervention list.

The symbols that Eli incorrectly identified were "sad", "angry", "scared", "homesick", "excited", "hopeful", "silly", "jealous", "sick" and "lonely".

2.3.2 Experimental Phases*:*

Baseline phase:

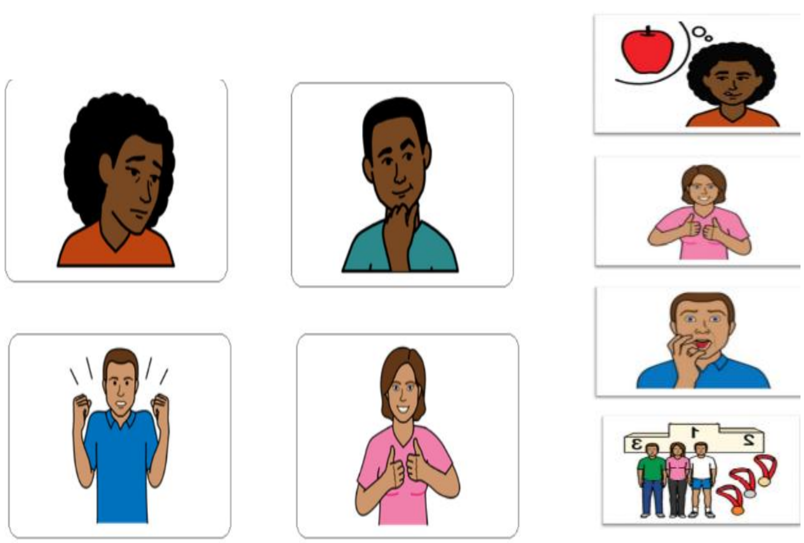
During baseline, the investigator shared their screen that depicted 4 symbols on it using the Zoom™ screen share function. One of the four symbols was a symbol Eli had incorrectly identified during the symbol selection assessment, and the other 3 symbols were foils. The researcher asked Eli to "Click on the ______ face!" (e.g. click on the "scared" face) and waited for 15 seconds. If no response was given, the researcher repeated the prompt once more. After a selection was made or the second prompt was given but no response was received, the researcher navigated to another set of four symbols and asked Eli to identify another emotion symbol. The researcher repeated the same instructions for all 10 of the symbols. After one trial, Eli listened to his favorite song as a reward. This process was repeated 3 times within the session.

After completing 3 baseline probes with each PCS® symbol, the researcher then did one baseline probe for the ten Symbolstix® symbols that depicted the same emotions as PCS® symbols. The Symbolstix® symbols were only probed once during the baseline phase.

Position effect and grid orientation change

Prior to each session, the location of each symbol was randomized to avoid position bias. During the first seven sessions of the experimental phase, the symbols were arranged on a 2x2 grid. During these sessions, Eli would perseverate and consistently select the symbol located in the left-upper corner of the 2x2 grid. To prevent the position bias, the grid orientation was changed from a 2x2 grid to a 1x4 grid. Eli did not perseverate on a symbol location with the 1x4 grid. Therefore, sessions after the seventh session were implemented with a 1x4 grid. Refer to figure 4 for depiction of the grid orientation change.

Figure 4: Orientation of Symbols



(a) Orientation of symbols for the first 7 sessions of the study. *(b) Vertical presentation of symbols after the 7th session.*

Intervention phase

Intervention was implemented after Eli completed three baseline probes for the PCS® symbols and one probe for Symbolstix® symbols. Intervention only included the PCS® symbols. Each intervention session consisted of three trials designed to teach symbol identification and three probes. The three teaching trials included systematic instruction including cueing and prompting. Systematic instruction (i.e. time delay, least-to-most prompting, error correction, and reinforcements) has been successfully used to teach target communicative behaviors using AAC methods in individuals with autism (Alzrayer et al., 2019; Chavers et al., (in-press); Lorah et al., 2015; Waddington et al., 2014). This involved researcher and Eli's mother providing instruction and cuing Eli on his symbol selections. Eli was given no instruction or feedback about his symbol selections during probes. The probes were used to measure Eli's progress without any cues or prompts. Specifically, a probe involved presenting Eli with four symbols, and asking him to click on the target symbol. If he did not answer, the probe was repeated once after 15 seconds. This intervention probe process was identical to the baseline probe phase where no feedback or cueing was provided during the trials.

During teaching trials, Eli was first presented with four symbols and asked to select a specific emotion. If Eli did not correctly select the correct symbol among four choices, the researcher said, "nice try, but that's not right" and crossed out the incorrect symbol in red. Then the researcher circled the correct symbol in green and described different features of the face, imitating the expression, circling notable parts of the face or drawing arrows to notable features. Then, the researcher would clear the annotations and ask Eli to click on the correct face. If Eli selected the incorrect symbol, the researcher then presented Eli with the choice among two symbols. If Eli selected the correct symbol on the first try among two choices, the researcher would circle his choice in green, providing praise saying “That’s right!, you picked the ______ face!” and describe features of the face. Then the researcher would present the participant with the choice among three symbols. If Eli answered correctly, the process as above was repeated and the researcher would present the choice among four symbols once more. If Eli selected the correct answer, his correct response was reinforced with a verbal phrase and/or a starburst and the researcher proceeded to the next symbol on the list.

If Eli selected incorrectly from a choice among two symbols, the researcher said, “nice try, but that’s not right” and crossed out the incorrectly chosen symbol in red. Then the researcher circled the correct symbol in green saying “This is the right face. This is the _____ face…” and described notable features of the face such as eyes, lips, etc. Then, the researcher would clear all of the annotations, including her own and request the participant to click on the correct symbol once more. If Eli selected incorrectly again, his caregiver provided hand-over-hand assistance to have him select the correct symbol. The above process was repeated with all individual symbols.

Eli’s target symbols were re-arranged for each session to prevent Eli from memorizing the placement of the symbols. Once Eli selected a symbol correctly during each probe trial for three consecutive probe trials, the symbol-referent relationship was considered to be acquired.

Generalization:

Generalization was initiated after Eli achieved 100% accuracy across three consecutive trials for all the PCS® symbols. During the generalization phase, Eli was asked to identify emotions depicted with Symbolstix® symbols instead of the PCS® symbols. This process was identical to the baseline phase.

2.3.3 Reliability

The purpose of the study and the operational definition of the dependent variables were explained to the independent observer, who is a PhD candidate in Speech, Language and Hearing sciences. Training continued until there was 100% agreement on whether the participant's response was acknowledged incorrect or correct between the experimenter and the observer. After training was completed, the observer collected real time data in at least 30% of sessions during baseline, intervention, and generalization sessions respectively. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements multiplied by 100. The agreement was 100% accuracy across all phases.

2.3.4 Treatment Integrity

Three separate procedural/treatment checklists – one for baseline procedures, one for intervention procedures, and one for generalization procedures – were developed (Schlosser, 2002). For baseline and generalization, critical procedural steps included the following (a) symbols were randomized to prevent position bias; and (b) researcher and/or Eli's mother did not provide prompts. For intervention phase, critical procedural steps included the following: (a) researcher waited 15 seconds before providing systematic instruction to teach symbol referent relationships; (b) symbols were randomized to prevent position bias; (c) researcher provided least-to-most prompting and (d) researcher described notable features of emotion when providing systematic instruction on a symbol-referent relationship. The observer and researcher met via Zoom™ to practice all the different phases. Training continued until the observer reached 100% accuracy in collecting treatment integrity data. After training, treatment integrity data were taken in real time for 30% of the sessions during baseline, intervention and generalization phases.

Procedural/treatment integrity was calculated by dividing the number of correctly performed steps by the total number of steps multiplied by 100. Treatment integrity was 100% across all phases.

2.4 Design

This study used a single-case A-B generalization design to analyze the behavior of one participant. Eli was administered the baseline phase (A), followed by the intervention (B), and a generalization phase.

III. Results

The purpose of this case study was to observe the effectiveness of telepractice as a service delivery model to teach symbol-referent relationships to an adult with ASD. Eli's results are presented below for the dependent variable (accuracy of identification of symbols that depict emotion). Visual analyses were used to examine changes in the dependent variable for baseline, intervention, and generalization phases. Only 8 of the 10 targeted symbols were taught as Eli was unable to complete all of the planned intervention sessions because of medical appointments and inability to access internet during extreme winter weather.

3.1 Baseline

Prior to the beginning of the intervention, Eli was unable to accurately and consistently identify target PCS® or Symbolstix® graphic symbols depicting emotions. The mean baseline correct identification score for PCS® symbols was 50% and for Symbolstix® symbols was 56.25%. His performance was variable and may have been because of his tendency to select symbols (i.e., position effect) on the left upper corner of the screen irrespective of the prompt. To avoid the position effect, the researchers changed the orientation of symbols from a 2x2 grid to a 1x4 grid after the first seven sessions (figure 4). The researcher also added the phrase, "wait for my question", prior to each prompt to avoid symbol selection by Eli prior to hearing the complete prompt. Because of high variability in responses due to the position effect, the baseline data for the first seven sessions for the symbols "excited", "sick", "lonely" and "scared" are not reported, and only data from session 8 onwards (after the orientation change) are reported for these four symbols. The symbols "homesick, "hopeful", "angry" and "sad" were only baselined previous to changing the orientation of the display, so their baseline data is limited to first seven sessions.

Because of variability no level or trend was observed during the baseline phase for these four symbols.

3.2 INTERVENTION AND GENERALIZATION

The results for the 8 symbols targeted are discussed below. The results are subcategorized into two subsections: Symbol set 1 and Symbol set 2. The performance of Eli on “homesick”, “hopeful”, “sad” and “angry” symbols are discussed under Symbol set 1. The baseline data was not recollected for these symbols after the grid orientation change. The performance of Eli on “sick”, “lonely”, “excited”, and “scared” symbols is discussed under Symbol set 2. For these symbols, baseline data was collected after the grid orientation change. Data are displayed graphically for “sick”, “lonely”, “excited” and “scared” symbols as these were the symbols with baseline data post- grid orientation.

3.2.1 Symbol Set 1: “Hopeful”, “Homesick”, “Sad”, and “Angry”

Data reported for these symbols are for sessions 1-7 before the grid orientation change. During baseline phase, Eli was unable to accurately identify the “hopeful” symbol (Mean=0%, SD=0). He also did not accurately identify the “homesick” symbol during baseline sessions (Mean=0%, SD=0). During intervention sessions, Eli met the acquisition criterion of 100% accuracy across 3 consecutive sessions for the “hopeful” symbol after 14 sessions of training and for the “homesick” symbol after seven sessions of training. The data for the “hopeful” symbol (Mean= 59.52%, SD=38.17, range=33.33%-100%) clearly indicated a change in level compared to baseline data (0%) and a change in trend. Data for the “homesick” symbol (Mean=14.42%, SD=43.30, range=0%-100%) indicated a small positive change compared to baseline (Mean=0%). However, his responses were quite variable. During the first six sessions of intervention, Eli’s tendency to respond without listening to the complete prompt and selecting symbols at a particular position may have contributed to a high rate of variability in his responses. After the orientation of symbols was changed from 2x2 to 1 x4 grid, Eli's selections were more consistent. During the generalization phase Eli was unable to identify the Symbolstix® symbol for "hopeful". However, he accurately identified the Symbolstix® symbol for "homesick".

During baseline sessions Eli did not consistently select the "sad" symbol accurately (Mean=13.32%, SD=26.66). During intervention sessions, Eli met the acquisition criterion for the "sad" symbol after ten sessions of training. The intervention data for the "sad" symbol (Mean=79.99%, SD=22.11, range=33.33%-100%) clearly indicated a change in level compared to baseline data (0%). During the generalization phase, Eli was able to identify the Symbolstix® symbol for "sad" accurately.

During baseline sessions Eli did not consistently select the "angry" symbol with accuracy (Mean=53.33%, SD=40.00). During intervention sessions, Eli met the acquisition criterion for the "angry" symbol after eleven sessions of training. However, the intervention data for the "angry" symbol (Mean=66.66%, SD=34.82, range=66.66-100%) did not indicate a change in level compared to baseline data (53.66%) or a change in trend. During the generalization phase Eli was able to identify the Symbolstix® symbol for "angry" accurately, despite minimal treatment effect for the "angry" symbol.

3.2.2 Symbol Set 2: "Sick", "Lonely", "Excited" and "Scared"

Data reported for the "sick", "lonely", "excited" and "scared" symbols are from sessions 8 and onwards after the grid orientation change. The data for the "sick" symbol is graphically displayed separately from the "lonely", "excited", and "scared" symbols because the "sick" symbol was baselined and treated in a different number of sessions than "lonely", "excited", and "scared" symbols (See Figures 5 and 6). During baseline sessions, Eli did not accurately select the “sick” symbol (Mean=0%, SD=0). During intervention sessions, Eli met the acquisition criterion for the “sick” symbol after eight sessions of training. The data for the “sick” symbol (Mean=83.33%, SD=23.57, range=33.33%-100%) indicated a change in level compared to baseline data (0%). During the generalization phase Eli was able to identify the Symbolstix® symbol for “sick” accurately.

Figure 5: Percent Accuracy for “Sick” Symbol Across Baseline, Intervention, and Generalization Sessions.

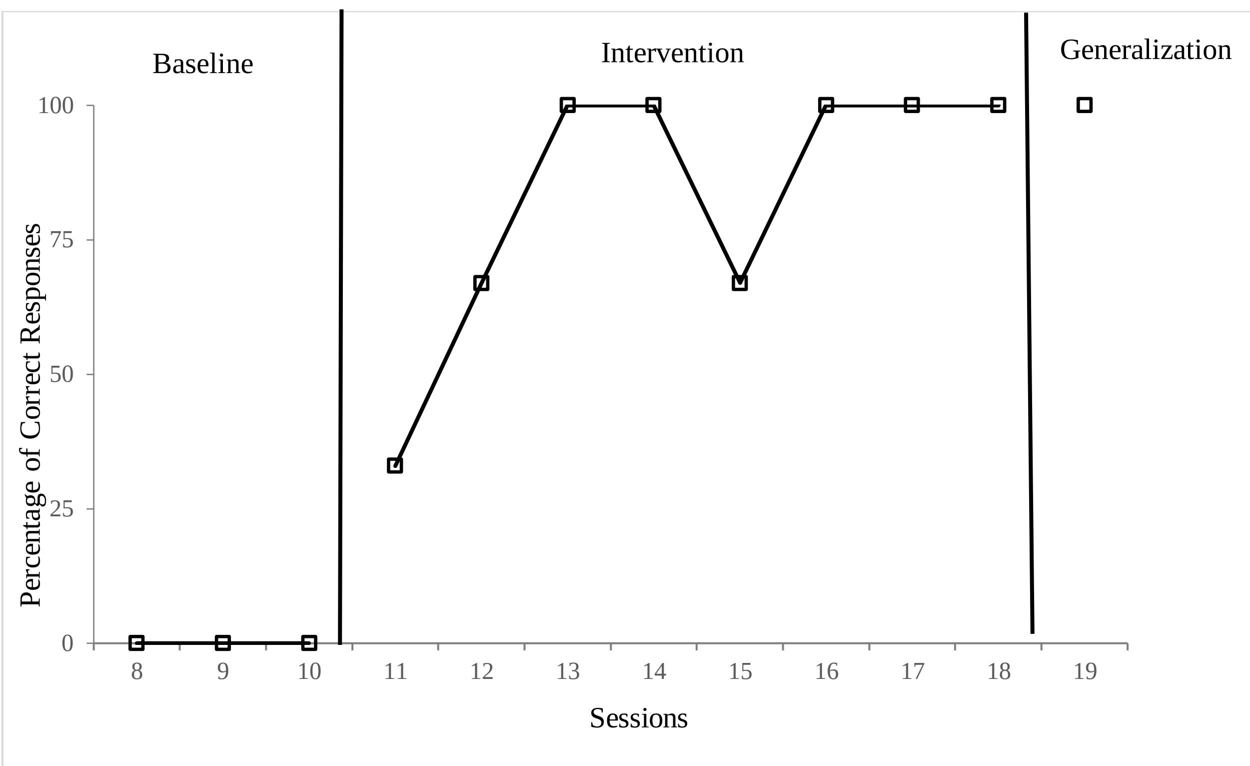


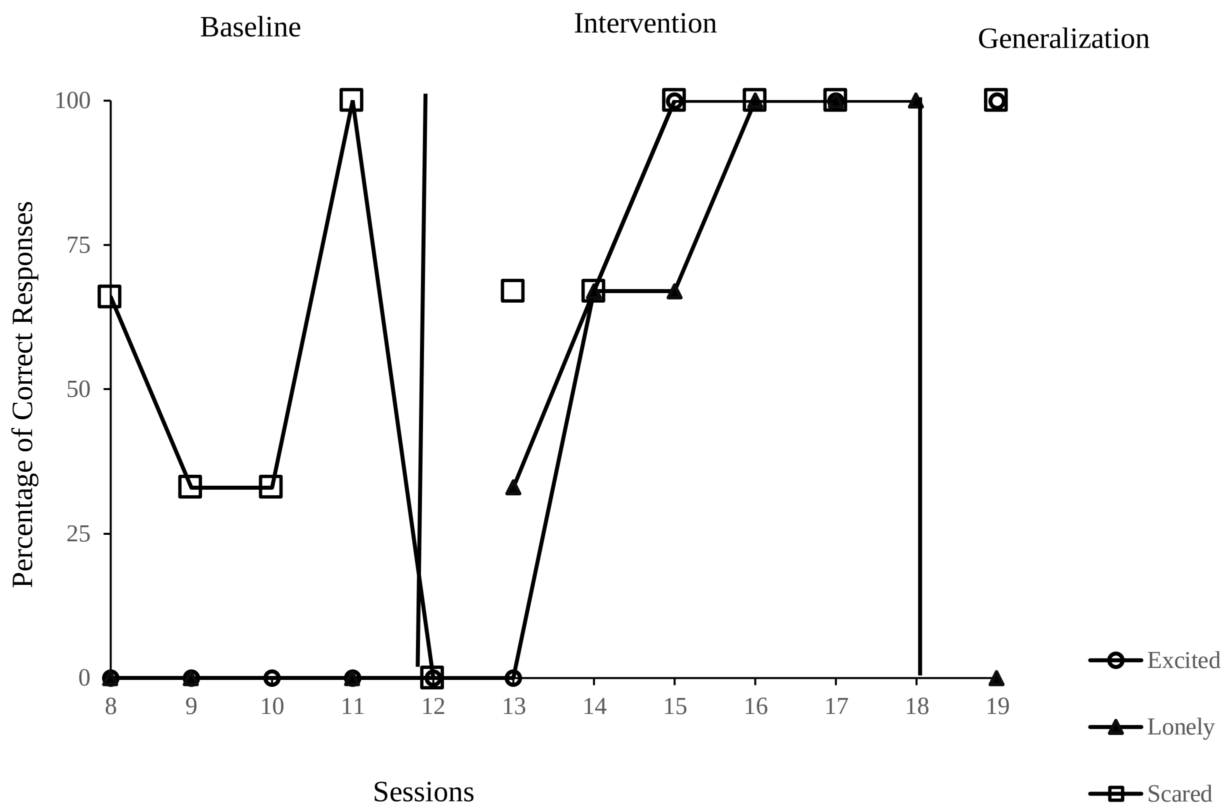
Figure 6 depicts data for “lonely”, “scared” and “excited” symbols. During the baseline sessions, Eli did not accurately select the “lonely” symbol (Mean=0%, SD=0). During intervention, Eli met the acquisition criterion for the “lonely” symbol after six sessions of training.

The intervention data for the “lonely” symbol (Mean=77.78%, SD=24.85, range=33.33%-100%) indicated a change in level compared to baseline data (0%). During the generalization phase Eli was unable to identify the Symbolstix® “lonely” symbol accurately.

During the baseline sessions, Eli did not accurately select the “excited” symbol (Mean=0%, SD=0). Eli met the acquisition criterion for the “excited” symbol after four sessions of training. The data for “excited” symbol (Mean=91.67%, SD=14.44, range= 66.66%-100%) clearly indicated a change in level compared to baseline data (0%). During the generalization phase Eli was able to identify the Symbolstix® symbol for “excited” accurately.

During the baseline sessions, Eli did not accurately select the “scared” symbol (Mean=0%, SD=0). During intervention sessions, Eli met the acquisition criterion for the “scared” symbol after four sessions of training. The intervention data for the “scared” symbol (Mean=91.67%, SD=14.44, range=66.66%-100%) indicate a change in level compared to baseline data (0%). During the generalization phase Eli was able to identify the Symbolstix® symbol for “scared” accurately.

Figure 6: Percent Accuracy for "Lonely", "Excited" and "Scared" Symbols Across Baseline, Intervention and Generalization sessions



3.3 DESCRIPTIVE DATA

At baseline, Eli was highly inconsistent in his symbol selections for both PCS® and Symbolstix® symbols. On average, he accurately identified 50% of the symbols during baseline for PCS® and 56.25% of the symbols for Symbolstix®. His baseline performance was inconsistent. Post-intervention, Eli identified PCS® with 100% accuracy and the Symbolstix® symbols with 75% accuracy; indicating clear improvement from baseline (see Figure 7).

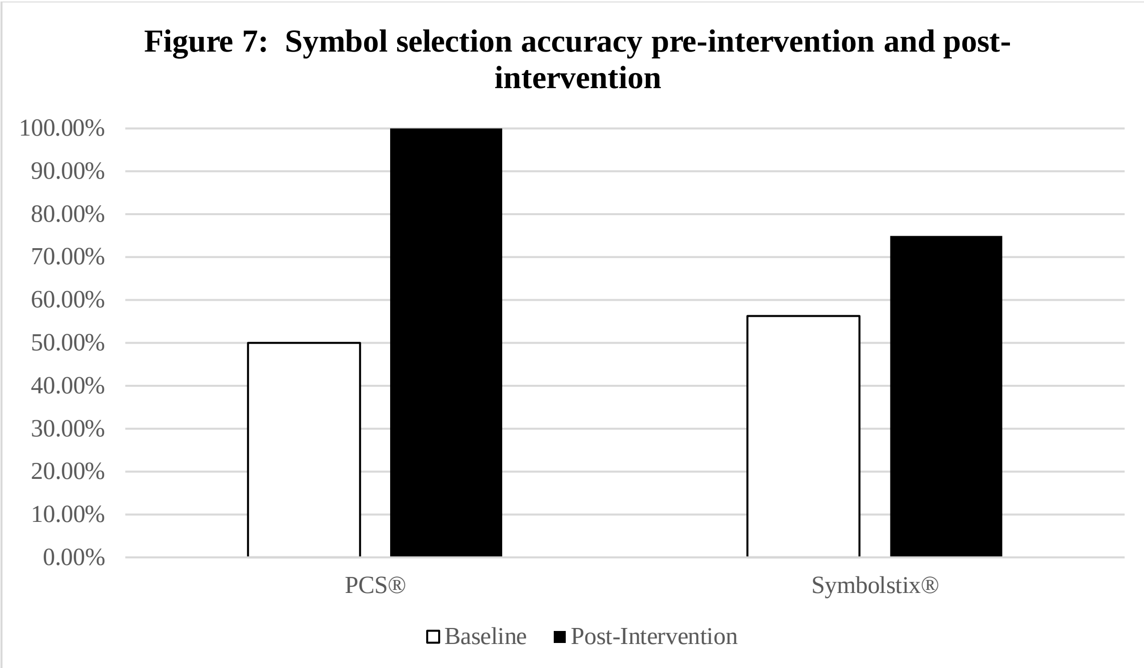


Figure 7: Symbol selection accuracy pre-intervention and post-intervention
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
PCS®
Symbolstix®
Baseline
Post-Intervention

IV. Discussion

This study investigated the effectiveness of telepractice as a service delivery model for intervention on symbol referent relationships for symbols that depict emotion with an adult with severe ASD and little to no functional speech. The results indicated that Eli was able to identify with higher accuracy both trained and untrained symbols depicting emotions. Specifically, post-intervention, Eli was able to identify PCS®, symbols with 100% accuracy. He also demonstrated generalization to untrained Symbolstix® symbols depicting the same emotions. His identification accuracy for Symbolstix® was 75%. This indicates that Eli's ability to understand symbol-referent relationships for symbols depicting emotions was not limited to just memorizing a specific symbol from a particular symbol set.

4.1 SYMBOL-REFERENT RELATIONSHIP

This appears to be the first study that investigated the effects of intervention on identification of symbols depicting emotions in adults with ASD using a telepractice format. The preliminary results indicate that telepractice can potentially be used to teach symbol-referent relationships for abstract such as the ones depicting emotions. Previous research on identification of symbols that depict emotions is limited to typically developing children (Deklerk, Dada, & Alant, 2014; Visser, Alant & Hardy, 2008). The current study extends this work to adults with ASD and the results obtained are consistent with the previous research. DeKlerk, Dada & Alant (2014) reported higher accuracy for symbols that depict positive emotions than those that depict negative emotions. Results from this study also revealed a lower percent identification for symbols depicting negative emotions (e.g., "sick", "lonely", and "angry") in contrast to symbols depicting positive emotions (i.e., hopeful, excited). The only symbol that depicted a potentially negative emotion and had higher accuracy was "scared". These results are consistent with previous research suggesting that individuals with ASD have greater difficulty identifying negative emotions than positive ones (e.g., Ashwin et al., 2006; Bal et al., 2010; Corden et al., 2008; Eack, Mazefsky & Minshew, 2014; Howard et al., 2000; Montgomery et al., 2016; Wallace et al., 2008). Further complex negative or positive emotions are harder to recognize than basic emotions (Friedenson-Hayo et al., 2016; Golan, O., Sinai-Gavrilov, & Baron-Cohen, 2015). These complex emotions are typically harder to depict graphically because they have abstract features and require attributing cognitive states (Harris, 1989). This is consistent with research that suggests it is easier to learn symbols for concrete concepts (e.g. cracker, cup) than symbols for abstract concepts (e.g. who, love; Hochstein et al., 2003; Koul, Schlosser, & Sancibrian, 2001; Light & Lindsay, 1992). Another aspect of difficulty with the graphic representation of symbols that depict emotion is that many emotions have similar characteristics (Visser, Alant, & Hardy, 2008). For example, angry, sad, jealous and lonely all have frowns on their faces to indicate displeasure. Symbols like excited and hopeful both have smiles on their faces to indicate pleasure or "good".

The overall findings in the current study are consistent with previous research that adults with severe ASD and limited to no functional speech benefit from AAC intervention that ranges from teaching basic symbol-referent relationship to complex social-communicative behaviors (Banda et al., 2010; Chavers, Morris, Schlosser, & Koul (in-press); Hong et al., 2014; Kee et al., 2012; Sigafoos, Drasgow et al., 2004; Sigafoos, O'Reilly et al., 2004; Reichle et al., 2005). Understanding symbol-referent relationships is critical to teaching early communicative behaviors such as requesting and rejecting and more complex social-communicative behaviors such as commenting, answering questions, turn taking, and engaging in small talk (Chavers et al. in-press). Additionally, previous studies have reported that accurate symbol identification is a precursor to obtaining positive results from treatment (e.g., Alzrayer et al., 2019; Chavers et al., (in-press); Lorah et al.,2014, Lorah, 2016; Tsai, 2013). Further, the current study also adds to the previous research suggesting that telepractice has potential to be an effective platform for therapy with individuals with ASD (Boisvert et al., 2010, 2016; Ellison et al., 2021; Hao et al., 2020; Lindgren et al., 2016; Pellegrino & Reed et al., 2020; Pollard et al., 2020; Tang et al., 2020).

Although, there are number of studies that have investigated emotional competence of individuals with ASD (Bradley et al., 2001; Petty, Allen, & Oliver, 2009; Saarni, 2011; & Wilkinson & Snell, 2011), face emotion recognition (Hobson, 1993; Harms, Martin, & Wallace, 2010; Gross, 2008; Karmiloff-Smith et al., 1995; Lozier & Vanmeter, 2014), and how individuals with ASD process emotional information (Corden et al., 2008; Baron-Cohen et al., 1997; Gross, 2008; Pelphrey et al., 2002), the researchers were unable to find research that has specifically focused on emotional competence of adults with severe ASD who have AAC needs. It is critical that the individuals with ASD who use AAC strategies and techniques are able to communicate about their emotional states (see Na et al., 2016 for a review). The current study provides preliminary data on identification of complex emotion symbols by an individual with severe ASD.

Finally, this study adds to the existing literature on the efficacy of the telepractice platform for AAC intervention with individuals with severe ASD. Currently, limited research exists on efficacy of intervention for diverse ASD populations via the telepractice format, and these studies largely have focused on children (see Boisvert et al., 2012 for a review). This study provides preliminary data on use of the telepractice platform for with adults with severe ASD who can benefit from AAC intervention.

4.2 Clinical Implications

This case study indicates that adults with severe ASD and limited to no functional speech can acquire and generalize symbol-referent relationships for symbols representing complex emotions across symbol sets. Additionally, this study provides preliminary data that supports use of the tele-practice platform in successfully teaching symbol-referent relationships to adults with severe ASD. However, the successful outcome is dependent on multiple factors including the quality of the telepractice platform, availability of committed AAC facilitators, and design of AAC interface that is not only individualized but also reduces overall cognitive load and promotes communicative success. For example, in the current study, the orientation of the symbols was changed from a 2x2 grid to a 1x4 grid to enhance identification accuracy and reduce error rate. In summary, successful results are achieved when the AAC system design features match client's strengths and capabilities across cognitive, physical, linguistic, symbol, and sensori-perceptual domains (Beukelmann & Light, 2020).

4.3 Limitations

The outcomes of this study should be considered in light of the following limitations. First, the case studies by their very nature lack internal validity as well as external validity. Second, the change in the orientation of the display after 7 sessions to enhance accuracy is a serious methodological concern. This critical concern amounted to separately analyzing data for symbols with baseline data after change in display orientation from those with no baseline data after change in display orientation. Finally, generalization data was collected for only one session and no maintenance data were collected because of lack of availability of the participant. Thus, the data in this study must be interpreted with caution.

V. Conclusion

The purpose of this case study was to investigate the effectiveness of telepractice in teaching symbols that depict emotions to an individual with autism and limited to no functional speech. The preliminary results suggest that symbol referent relationships for abstract symbols that depict emotions can be taught using telepractice format. However, the results of this study must be interpreted with caution because of methodological concerns that impact internal validity.

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